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(72) Inventor GEORGE CYRIL SEYMOUR PEARSON

(54) IMPROVEMENTS IN OR RELATING TO PRESSURE TRANSMITTING DEVICES

(71) We, PEARSON INTERNATIONAL LIMITED, a British Company, of 11 St. Martins-le-Grand, London, E.C.1., do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to pressure transmitting devices.

The invention provides a pressure transmitting device comprising a hollow body having a wall formed with straight, parallel slots to render the wall flexible, the hollow in the body being filled with a solid plastics material which yields resiliently when subjected to load and means being provided for applying pressure to or responding to pressure in the plastics material to displace and apply pressure through the flexible wall or respond to a displacement of the flexible wall.

A membrane may be provided between the slotted wall and the plastics material to prevent extrusion of the plastics material into the slots.

In one embodiment of the invention the hollow body comprises a cylinder, the cylinder containing the plastics material and means being provided to compress the plastics material axially within the cylinder and thereby expand the flexible wall of the cylinder to grip a bore in a component encircling the cylinder.

In the latter arrangement the cylinder may have a fixed wall at one end and an axially movable wall at the other end and the means to compress the plastics material axially comprise means to move the movable wall towards the fixed wall.

The means to move the movable wall may comprise a bolt connecting the movable wall to the fixed wall, the bolt being screwed into the fixed wall so that rotation of the bolt adjusts the movable wall towards and away from the fixed wall.

Alternatively the means to move the movable wall towards and away from the fixed wall may comprise a screw-threaded stud projecting from the fixed wall along the cylinder and through the movable wall, the movable wall being retained on the stud by a nut screwed onto the stud adjustment of which adjusts the movable wall towards and away from the fixed wall.

In a further embodiment of the invention the cylinder may have end walls at both ends thereof which close the cylinder and one end wall has an axially projecting spigot extending away from the cylinder which is encircled by a collar screw threaded onto the spigot, and wherein a piston member is located within the body adjacent said one end for applying pressure to the plastics material within the cylinder and a number of axially extending plungers are slidably mounted in said one end wall between the collar and the piston member so that by rotating the collar to move the collar along the spigot towards said one end of the wall pressure is applied to the plastics material by the piston member.

In the latter case a ring may be provided between the collar and the ends of the plungers which extend from the end wall of the cylinder and a bearing may be provided between the ring and collar.

The end wall on which the spigot is formed may be integral with the cylinder body and the opposite end wall may be screwed into the cylindrical body or vice versa.

The slots may extend axially and may stop short of the ends of the cylinder to render.

The outer surfaces of end portions of the cylinder may be screw threaded to receive internally threaded collars for locating a workpiece on the cylinder prior to gripping of the workpiece by expansion of the por-

tion of the cylinder between the collars.

In a further embodiment of the invention the hollow body may comprise a rigid outer cylinder, an inner cylinder forming the slotted wall, the plastics material being enclosed between the inner and outer cylinders so that pressure applied to the plastics material causes contraction of the inner cylinder to grip a tool workpiece located within the cylinder.

More specifically the outer cylinder may be closed at one end and have an opening at the other end to receive a tool or workpiece and the slots may extend axially to one end of the cylinder adjacent the open end of the outer cylinder said end of the inner cylinder having an outer rim through which said slots extend and the side of the rim facing the plastics material between said inner and outer cylinder being frusto-conical.

In the latter arrangement a ring may be provided between the rim and the plastics material, the ring having a frusto-conical surface which engages the frusto-conical surface of the rim so that pressure from the plastics material compresses and closes the inner cylinder and urges the ring axially to maintain contact with both the rim on the cylinder and the outer cylinder.

The closed end of the cylinder may have a bore in which the other end of the inner cylinder is located the inner cylinder being held in the outer cylinder by a cap secured to said open end of the outer cylinder which engages the adjacent end of the inner cylinder and which cap has a central aperture through which a tool or workpiece can be inserted into the inner cylinder.

A ring may be provided around the inner cylinder betwen the plastics material and the closed end of the outer cylinder, which may have a spigot projecting away from the cylinder on which a collar is screwed and a number of plungers extend through the end wall of the cylinder between the collar and ring so that screwing of the collar along the ring applies pressure in an axial direction to the plastics material.

In the latter case the ends of the plungers outside the cylinder may bear against the non-rotating ring on the spigot and the screw threaded collar acts against the non-rotating ring through a bearing.

A membrane may be provided between the plastics material and inner cylinder to prevent extrusion of the plastics material to the slots of the inner cylinder.

In a further embodiment the hollow body forms one side of a clamping device and the flexible wall forms a clamping surface of the clamping device.

In yet a further embodiment of the invention for responding to pressure applied to the flexible wall, an indicator may be provided which is responsive to flow of the plastics material to indicate the extent of deflection of the wall.

More specifically the flexible wall may comprise an axially slotted sleeve the diameter of which increases towards the centre of the sleeve, the sleeve containing the plastics material and means being provided in response to axial flow of the plastics material to operate the indicator so that radially inward deflection of the flexible wall is indicated by the indicator.

In any of the above arrangements the plastics material may be polyurethane and the hollow body may be formed in a metal such as steel.

The following is a description of some specific embodiments of the invention reference being made to the accompanying diagrammatic drawings in which:—

Figure 1 is a sectional, side elevation of an expandable mandrel;

Figure 2 is an elevation of part of the mandrel shown in Figure 1;

Figure 3 is a diagrammatic drawing showing the action of the mandrel at an initial gripping stage;

Figure 4 is a similar view to Figure 3 showing the mandrel in a fully gripping position;

Figure 5 is a sectional part-side elevation of a vice.

Figure 6 is a part-sectional part-side elevation of a bore measuring gauge;

Figure 7 is a sectional view through a modified form of the mandrel shown in Figure 1;

Figure 8 is a sectional view through a further form of mandrel;

Figure 9 is a sectional view through a chuck for holding a tool or workpiece;

Figure 10 is an end view of the chuck shown in Figure 9;

Figure 11 is a side view of a split sleeve of the chuck shown in Figure 9;

Figure 12 is a section view through a modified form of the chuck shown in Figure 9.

Referring firstly to Figure 1 of the drawings there is shown an expandable mandrel comprising a hollow steel cylinder 10 which is closed by an integral wall 11 at one end. The wall of the cylinder is formed with axially extending circumferentially spaced slots 12 which stop short of the ends of the cylinder. The width of the slots is such that the wall of the cylinder can be flexed.

The inner periphery of the slotted portion of the cylinder 10 is encircled by a flexible membrance 13 and a sleeve of polyurethane 14 is fitted within the membrane. The membrane may not be required where, for the particular arrangement concerned, pressures are such that extrusion of the polyurethane into the slots does not occur. One end of

the sleeve 14 abuts the inside of the end wall 11 and the other end of the sleeve is engaged by a separate end wall 15 which is slidable axially within the cylinder. A threaded bolt 16 extends through the plastics sleeve 14 to a threaded bore 17 in the end wall 11. The head of the bolt locates in a recess in the sliding end wall 15 and by tightening the bolt into the end wall 11, the end wall 15 is drawn towards the end wall 11 to compress the sleeve of polyurethane 14 axially.

The axial compression of the polyurethane material causes radial flow of the polyurethane which expands the slotted portion of the cylinder radially outwardly. The membrane 13 prevents the polyurethane from being extruded through the slots. Rotation of the bolt 16 in the opposite direction releases the axial compression of the polyurethane thereby allowing the cylindrical body to contract.

In use a holder 19 of the mandrel is mounted in a conventional fixing device such as a chuck or collet and the cylindrical body 10 is inserted in the bore of a component 20 as shown diagrammatically in Figures 3 and 4 with the cylindrical body in the contracted state. The bolt 16 is then rotated to effect radial expansion of the cylinder which initially expands at its centre to engage the encircling bore in the component as shown in Figure 3. The expansion then spreads axially along the cylinder in both directions until substantially all the slotted portion of the cylinder is firmly compressed against the bore to grip the component as shown in Figure 4. It will be appreciated that the cylindrical body will expand automatically to the mean diameter of the bore in the component.

It will be appreciated that the radial expansion of the mandrel is limited and so the range of bores which the mandrel can grip is limited. To extend the range of bores which the mandrel can grip a set of sleeves of differing wall thickness fitted on the mandrel is provided. Each sleeve may be formed with longitudinal slots which stop short of the ends of the sleeve similar to the slots 12 in the cylinder 10 so that the sleeve will expand and contract with the mandrel. Also each sleeve has a longitudinal slot extending the full length of the sleeve and the sleeve is formed so that it has to be sprung open slightly to pass over the mandrel so that when released the sleeve firmly grips the mandrel.

Referring now to figure 5 of the drawings there is shown a vice comprising a bed 21 having a fixed jaw 22 at one end thereof. A movable jaw 23 is mounted on the bed 21 opposite the jaw 22 and the position of the movable jaw 23 is adjusted with respect to the fixed jaw 22 by a lead screw 24 which engages in a housing 25 mounted on the bed. A steel body 26 is mounted on the side of the jaw 23 to face the jaw 22, the body 26 having a cavity 27. The wall of the body on a side of the cavity facing the jaw 22 is formed with horizontal or vertical slots to permit the wall to flex and a flexible membrane 28 extends over the flexible wall within the cavity. A plastics core 29 fills the remainder of the cavity 27. The wall of the cavity adjacent the jaw 23 has an opening 30 through which a plunger 31 extends the plunger being mounted on a lead screw 32 which is in threaded engagement with a screw-threaded bore 33 so that rotation of the lead screw 32 adjusts the position of the plunger 31 in the aperture 30. Thus pressure can be applied by the plunger 31 by adjustment of the lead screw to the plastic core within the cavity 27 to deflect the slotted wall of the body 26.

In use a component is clamped between the jaws 23, 22 by first adjustment of the lead screw 24 and then the lead screw 32 is turned until the slotted wall of the body has been deflected sufficiently to clamp the body to the jaw 22 and to engage the body substantially over the whole area of the wall.

Reference is now made to Figure 6 of the drawings which shows a bore measurement gauge. The gauge comprises a steel sleeve 35 which is barrel-shaped as indicated at 36 intermediate its ends and the barrel-shaped portion of the sleeve is formed with circumferentially spaced axially extending slots 37. The inner periphery of the barrel shaped portion of the sleeve is lined by a flexible membrane 38 and a core 39 of plastics material is fitted within the membrane. One end of the core 39 is engaged by a piston member 40 which is axially slidable in one end of the sleeve. An indicator device 41 is secured to one end of the sleeve and the device has an operating push rod 42 which bears on the opposite side of the piston 40 to the core 39. The other end of the core 39 is engaged by a plug 43 which is held in the sleeve by a bolt 44 screwed into the end of the sleeve and a spring washer 45 is located between the head of the bolt and the end of the sleeve.

Radial compression of the slotted portion of the sleeve 35 will cause axial flow of the core 39 of plastic material which will in turn, displace the piston 40 and thence the push rod 42 to operate the indicator 41. The indicator can be zeroed or set to a particular value by adjustment of the bolt 44 and then the sleeve 35 is inserted in a bore. If the bore diameter is less than the outer diameter of the sleeve the sleeve will be compressed and indicator will give a reading determined by the extent of the

compression.

The mandrel shown in Figure 7 is intended for holding between centres and is similar in construction to the mandrel shown in Figure 1 of the drawings and like parts have been alotted the same reference numerals.

The mandrel comprises a hollow steel cylinder 10 closed at one end by an integral end wall 11 and having circumferentially spaced axially extending slots 12 over the centre portion of the cylinder to render the centre portion flexible.

The cylinder 10 may contain a flexible membrane 13 within which there is a solid cylinder 14 of a plastics material.

The other end of the cylinder 10 is closed by an end wall 100 which is screwed into the sleeve. The end wall has an integral spigot 101 which projects axially away from the cylindrical body. A collar 102 encircles and is in screw threaded engagement with the spigot. A piston member 103 is located within the cylinder 10 adjacent the end wall 100.

The piston member 103 is slidable along the cylinder 10 to apply pressure to the plastics cylinder. A number of plungers 104 extend axially through the end wall 100. The plungers bear on the piston member 103 within the cylinder 10 and engage a ring 105 encircling the spigot 101 outside the cylinder. A bearing 106 or low friction washer is interposed between the collar 102 and the ring 105 so that the collar can be rotated with respect to the ring with little frictional drag. By screwing the collar 102 along the spigot 101 towards the end wall 100 the axial movement of the collar is transmitted through the ring 105 and plungers 104 to the piston member 103 which thereby compresses the plastics cylinder 14 against the end wall 11 of the cylinder. The resulting radial expansion of the plastics cylinder 14 causes radial expansion of the cylinder 10 to grip a workpiece encircling the mandrel.

The collar 102 may be hexagonal in outer contour for rotation by a spanner or the collar may be circular and knurled and drilled for rotation by a C-shaped spanner or a tommy bar.

In a further arrangement the diameter of the collar 102 is reduced to that shown in dotted outline and the end wall 11 is formed with an axially projecting spigot 107 again illustrated in dotted outline. The mandrel can then be used for chuck holding.

Further, the end portions of the cylinder indicated at 108 and 109 can be screw threaded to receive locating collars for positioning of a workpiece along the mandrel before it is gripped.

The mandrel shown in Figure 8 is also of similar construction to that of Figure 1 and again like parts have been alotted the same reference numeral.

The closed end of the cylinder 10 has a tapered shank 110 projecting away from the cylinder to be gripped in the hollow spindle of a machine tool. The shank has a bore 111 which is counter bored at the end of the shank as shown at 111*a*. A rod 112 extends through the cylinder 10 and shank 110 into the counterbore where the rod is screwed into a plug 113 located in the counter bore. The plug has shoulders 114 on either side thereof which fit in recesses 115 on either side of the counterbore to prevent rotation of the plug in the counterbore.

The part of the rod 112 extending through the cylinder 10 is fitted with a sleeve 112*a* which is encircled by a sleeve of plastics material 14. The rod projects through the open end of cylinder 10. At the open end of the cylinder 10 there is a bush 116 which is slidable on the sleeve and engages the sleeve of plastics material 14 within the cylinder.

The end portion of the rod is screw threaded and receives a combined ring and nut 117 which acts on the bush 116 through a bearing 118. The ring and nut is tightened on the rod 112 to force the bush 116 into the cylinder to compress the sleeve of plastics material 14 axially and thereby expand the mandrel.

A threaded draw bar 119 may be screwed into the outer end of the plug 113 if required. Operation of the drawbar either by rotation in the threads of the plug 113, or by pulling it mechanically, hydraulically or pneumatically, draws with it the plug 113 and consequently the rod 112, and nut 117. This action forces the bush 116 into the cylinder to compress the plastics material 14 and thereby expand the mandrel.

A locating collar 120 may be screwed into the closed end of the cylinder 10 to locate a workpiece on the cylinder prior to gripping if required.

Referring now to Figures 9 to 11 there is shown a chuck for holding a tool or workpiece comprising a hollow cylindrical housing 200 which is closed at one end by an end wall 201. Integral with the end wall 201 is a central spigot 202 which projects away from the housing 200.

Located concentrically within the housing 200 is a longitudinally slit sleeve 203, which receives a tool or workpiece to be held by the chuck. A bore 204 extends through the end wall 201 into the spigot 202 and one end of the sleeve 203 fits in the hole. The sleeve 203 is also pinned to the wall 201 by pins not shown to prevent rotation thereof in the housing. The sleeve 203 has longitudinal slots 205 spaced circumferentially around the sleeve, the slots extending

from the end of the sleeve adjacent the open end of the housing and stopping short of the other end of the sleeve.

At the end of the sleeve adjacent the open end of the housing the sleeve has an outer rim 203*a* and the outer periphery of the rim engages the inner periphery of the housing. The slots 205 in the sleeve also extend through the rim. A back face 206 of the rim is frusto-conical in contour for a purpose described later.

The sleeve is held *in situ* in the housing by end cap 207 which is screwed on to the open end of the housing 200. The end cap bears against the rim 203*a* of the sleeve. The end cap has a central aperture 208 in register with the opening in the sleeve through which a tool or workpiece to be gripped by the chuck is inserted into the sleeve.

The space between the split part of the sleeve 203 and the housing 200 contains a filling 209 of a plastics material such as polyurethane. A compression ring 210 is located between the filling 209 and the end wall 201 of the housing. A number of pins 211 bear against the pressure ring 210, the pins being slidably mounted in bores 212 in the end wall 201 of the housing. The ends of the pins outside the housing are engaged by a loose ring 213 and an actuating collar 214 which is screw-threaded on to the spigot 202 and acts against the ring 213 through a low friction surface bearing 215. By screwing the collar 214 towards the housing 200 pressure is applied to the plastics filling 209 through the bearing 215, collar 213, pins 211 and compression ring 210 which compressed the split sleeve 203 to grip a tool or work piece located within the sleeve. The pressure in the plastics material is relieved to release the gripping action by screwing the actuating collar 214 away from the housing. The actuating collar 214 has an integral sleeve 217 which embraces the adjacent end of the housing 200 to enclose the ring 213 and bearing 215.

A triangular section ring 216 is located between the back face 206 and the filling 209. One face of the ring engages the inner periphery of the housing 200 another face of the ring engages the back face 206 and the third face of the ring engages the filling. The ring may be a split ring to permit it to expand and contract. Pressure in the plastics filling 209 closes the sleeve 203 and moves its encircling rim 203*a* from the inner periphery of the housing 200. The pressure of the plastics filling on the ring 216 moves the ring longitudinally to fill or take up the space created by the closure of the sleeve.

The spigot 202 beyond the screw-threaded part engaged by the collar 214 is tapered and engages in a tapered bore in a conventional adaptor 218 which fits a spindle nose of a machine. A key 219 prevents the spigot from rotating relatively to the adaptor.

There is a long screw-threaded bore extending through the spigot and the adaptor 218 is secured to the spigot by a short set screw 220 which engages in one end of the bore. A length of screw-threaded studding 222 is located in the remainder of the bore and projects into the slit sleeve 203 to provide a stop to limit insertion of a tool or work piece into the chuck.

It will be understood that many modifications may be made to the above chuck without departing from the scope of the invention. For example the adaptor may be of different shape and design from that shown in accordance with the type and design of machine on which the chuck is to be mounted. Also the spigot 202 may be a cylindrical spigot, and/or provided with a screw-thread and/or key as required.

Furthermore in the case where a chuck is required to hold a work piece, the spigot of the chuck may be located and screwed into a back plate to be fitted to a back plate or face plate of a centre lathe or similar machine.

Figure 12 shows a modified form of the chuck shown in Figures 9 to 11. The chuck has a cylindrical body 230, bored and counterbored to accept a cylindrical plug 231, this latter being itself bored to accept a male centre 232. A hole is drilled and tapped into the side of the body 230 to take a threaded plug 233. The annulus between the body 230 and the plug 231, is filled with a plastics core, 234, the plastics extending into the drilled hole into which the screwed plug 233 is fitted.

The plastics core 234 is contained within the body 230 by a loose compression ring 235, on the other side of which is a further plastics core 236, located between the body 230 and a sleeve or collet 237. A tapered ring 238 which may be slit to allow expansion is fitted between the body 230 and the tapered end of the collet 237 and the whole is contained by a screwed end cap 239.

The collet 237 at the other end fits into the plug 231 and is located in it by two or more pins 240. The collet 237 may be plain to accept a tool having a plain shank or, as shown in the sketch, threaded on the inside at the end where it fits into the plug 231 to accept a tool having a screwed shank. The collet 237 has a number of longitudinal slots spaced equidistantly round its circumference. The slots permit contraction of the collet around a tool within the collet. The slots terminate at some distance from the end that fits into the plug 231.

The body is extended in any one of a variety of forms to fit the spindle of a

machine. In the sketch the form is appropriate to a No. 30 International Taper machine spindle.

In operation the shank of the tool is inserted into the chuck, being screwed down if the shank is threaded into the end of the collet 237 and against the male centre 232. The plug 233 is screwed inwards. This action displaces the plastics core 234 in the annulus and forces the compression ring 235 towards the end of the chuck, thus compressing the main plastics core 236 and contracting the collet 237 onto the shank of the tool. As the tapered end of the collet 237 closes inwardly the tapered ring 238 is forced towards the end cap 239 providing a continuous positive location between tool, sleeve, ring and body.

WHAT WE CLAIM IS:—

1. A pressure transmitting device comprising a hollow body having a wall formed with straight, parallel slots to render the wall flexible, the hollow in the body being filled with a solid plastics material which yields resiliently when subjected to load and means being provided for applying pressure to or responding to pressure in the plastics material to displace and apply pressure through the flexible wall or respond to a displacement of the flexible wall.

2. A pressure transmitting device as claimed in claim 1 wherein there is a membrane between the slotted wall and the plastics material to prevent extrusion of the plastics material into the slots.

3. A pressure transmitting device as claimed in claim 1 or claim 2 wherein the hollow body comprises a cylinder, the cylinder containing the plastics material and means being provided to compress the plastics material axially within the cylinder and thereby expand the flexible wall of the cylinder to grip a bore in a component encircling the cylinder.

4. A pressure transmitting device as claimed in claim 3, wherein the cylinder has a fixed wall at one end and an axially movable wall at the other end and the means to compress the plastics material axially comprise means to move the movable wall towards the fixed wall.

5. A pressure transmitting device as claimed in claim 4 wherein the means to move the movable wall comprise a bolt connecting the movable wall to the fixed wall, the bolt being screwed into the fixed wall so that rotation of the bolt adjusts the movable wall towards and away from the fixed wall.

6. A pressure transmitting device as claimed in claim 4 wherein the means to move the movable wall towards and away from the fixed wall comprise a screw-threaded stud projecting from the fixed wall along the cylinder and through the movable wall, the movable wall being retained on the stud by a nut screwed onto the stud adjustment of which adjusts the movable wall towards and away from the fixed wall.

7. A pressure transmitting device as claimed in claim 3 wherein the cylinder has end walls at both ends thereof which close the cylinder and one end wall has an axially projecting spigot extending away from the cylinder which is encircled by a collar screw threaded onto the spigot, and wherein a piston member is located within the body adjacent said one end for applying pressure to the plastics material within the cylinder and a number of axially extending plungers are slidably mounted in said one end wall between the collar and the piston member so that by rotating the collar to move the collar along the spigot towards said one end of the wall pressure is applied to the plastics material by the piston member.

8. A pressure transmitting device as claimed in claim 7 wherein a ring is provided between the collar and the ends of the plungers which extend from the end wall of the cylinder and a bearing is provided between the ring and collar.

9. A pressure transmitting device as claimed in claim 7 or claim 8 wherein the end wall on which the spigot is formed is integral with the cylindrical body and the opposite end wall is screwed into the cylindrical body.

10. A pressure transmitting device as claimed in any of claims 4 to 10 wherein the slots are axially extending and stop short of the ends of the cylinder.

11. A pressure transmitting device as claimed in any of claims 3 to 10 wherein the outer surfaces of end portions of the cylinder are screw threaded to receive internally threaded collars for locating a workpiece on the cylinder prior to gripping of the workpiece by expansion of the portion of the cylinder between the collars.

12. A pressure transmitting device as claimed in any of claims 1 to 3 wherein the hollow body comprises a rigid outer cylinder, an inner cylinder forming the slotted wall and said plastics material being enclosed between the inner and outer cylinders so that pressure applied to the plastics material causes contraction of the inner cylinder to grip a tool or workpiece located within the cylinder.

13. A pressure transmitting device as claimed in claim 13 wherein the outer cylinder is closed at one end and has an opening at the other end to receive a tool or workpiece and the slots extend axially to the end of the inner cylinder adjacent the open end of the outer cylinder said end of the inner cylinder having an outer rim through which said slots extend and the side of the rim facing the plastics material be-

tween said inner and outer cylinders being frusto-conical.

14. A pressure transmitting device as claimed in claim 14 wherein a ring is provided between the rim and the plastcs material, the ring having a frusto-conical surface which engages the frusto-conical surface of the rim, so that pressure from the plastics material compresses and closes the inner cylinder and urges the ring axially to maintain contact with both the rim on the inner cylinder and the outer cylinder.

15. A pressure transmitting device as claimed in claim 13 or claim 14 wherein the closed end of the outer cylinder has a bore in which the other end of the inner cylinder is located and the inner cylinder is held in the outer cylinder by a cap secured to said open end of the outer cylinder which engages the adjacent end of the inner cylinder and which cap has a central aperture through which a workpiece can be inserted into the inner cylinder.

16. A pressure transmitting device as claimed in any of claims 13 to 15 wherein a ring is provided around the inner cylinder between the plastics material and the closed end of the outer cylinder, which has a spigot projecting away from the cylinder on which a collar is screwed and a number of plungers extend through the end wall of the outer cylinder between the collar and ring so that screwing of the collar along the spigot applies pressure in an axial direction to the plastics material.

17. A pressure transmitting device as claimed in claim 16 wherein the ends of the plungers outside the cylinders bear against a non-rotating ring on the spigot and the screw threaded collar acts against the non-rotating ring through a bearing.

18. A pressure transmitting device as claimed in claim 1 or claim 2 wherein the hollow body forms one side of a clamping device and the flexible wall forms a clamping surface of the clamping device.

19. A presure transmitting device as claimed in claim 1 or claim 2 for responding to pressure applied to the flexible wall wherein an indicator is provided which is responsive to flow of the plastics material to indicate the extent of deflection of the wall.

20. A pressure transmitting device as claimed in claim 19 wherein the flexible wall comprises an axially slotted sleeve the diameter of which increases towards the centre of the sleeve, the sleeve containing the plastics material so that radially inward deflection of the flexible wall is indicated by the indicator.

21. A pressure transmitting device as claimed in any of the preceding claims wherein the plastics material is polyurethane.

22. A presure transmitting device as claimed in any of the preceding claims wherein the hollow body is formed in a steel.

23. A mandrel substantially as described with reference to and as illustrated in Figures 1 to 4 of the drawings.

24. A vice substantially as described with reference to and as illustrated in Figure 5 of the drawings.

25. A measuring indicator substantially as described with reference to and as illustrated in Figure 6 of the drawings.

26. A mandrel substantially as described with reference to and as illustrated in Figure 7 of the drawings.

27. A mandrel substantially as described with reference to and as illustrated in Figure 8 of the drawings.

28. A chuck substantially as described with reference to and as illustrated in Figures 9 to 11 of the drawings.

29. A chuck substantially as described with reference to and as illustrated in Figure 12 of the drawings.

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1397085 COMPLETE SPECIFICATION

3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

Fig. 1.

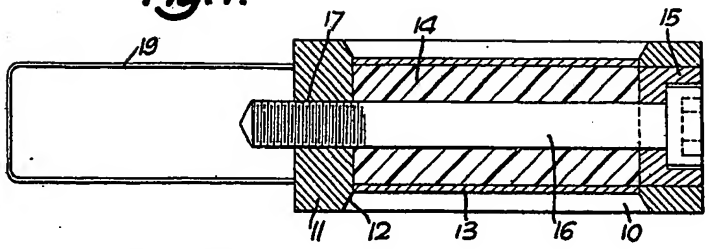


Fig. 2.

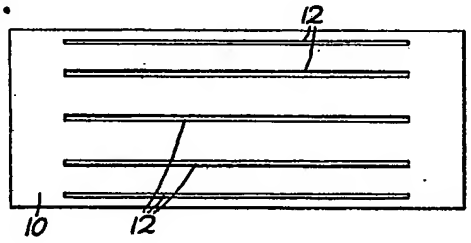


Fig. 3.

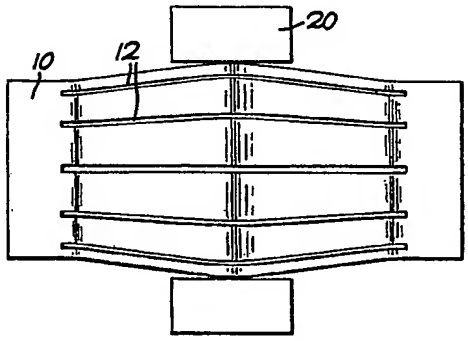


Fig. 4.

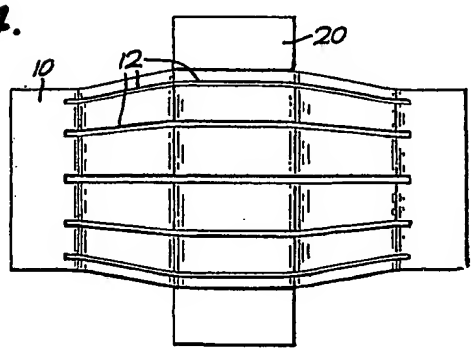


Fig.5.

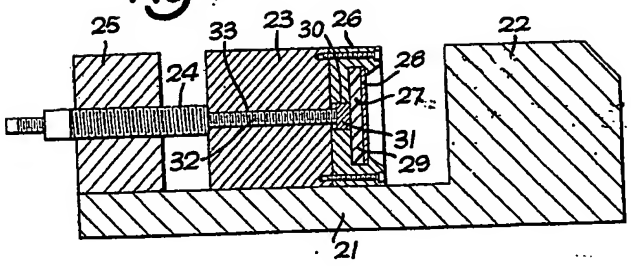


Fig.6.

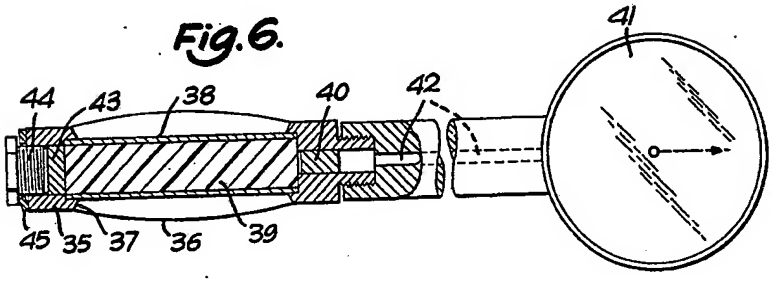


Fig.7.

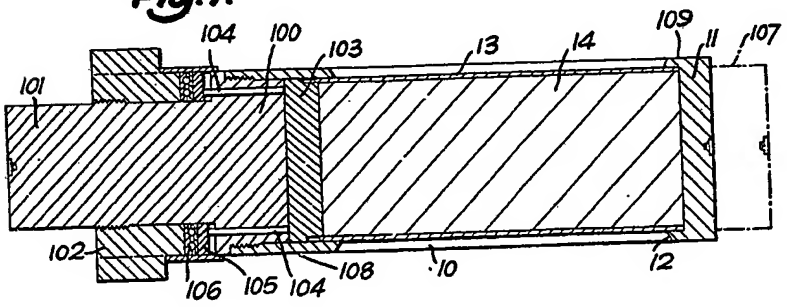
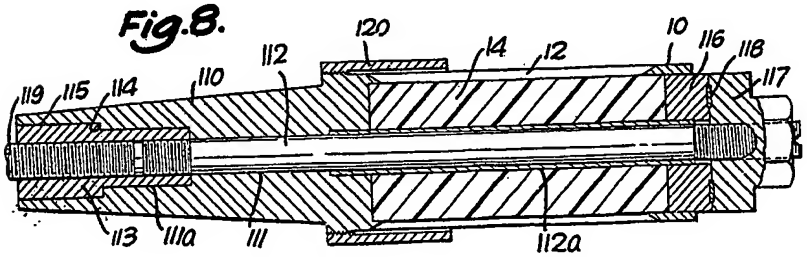


Fig.8.



1397085 COMPLETE SPECIFICATION

3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 3

Fig.9.

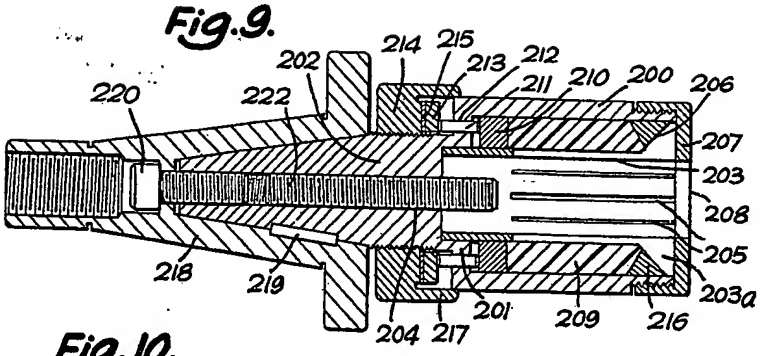


Fig.10.

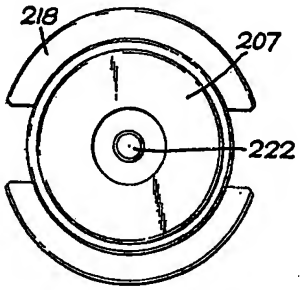


Fig.11.

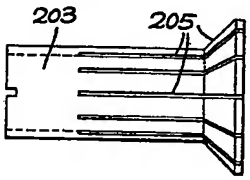


Fig.12.